

AMENDMENTS TO THE CLAIMS

Claims 1-7 (canceled).

Claim 8 (currently amended). A method for processing a surface of a semiconductor wafer comprising the steps of:

- a) removing a material layer overlying a barrier layer from the ~~wafer~~ surface of the semiconductor wafer at a ~~primary~~ chemical-mechanical polishing station with a ~~primary~~ chemical-mechanical polishing pad and using an abrasive slurry; and
- b) removing the barrier layer from the ~~wafer~~ surface of the semiconductor wafer at a buff station using a ~~set of buff station parameters~~ buff pad and a first barrier layer slurry.

Claim 9 (original). The method of claim 8, further comprising the step of buffing the wafer surface after barrier layer removal.

Claim 10 (previously presented). The method of claim 9, wherein a set of buff station parameters are different for the barrier layer removal step than for the buffing step.

Claim 11 (original). The method of claim 8, wherein a different slurry composition is used for the barrier layer removal step than for the buffing step.

Claim 12 (original). The method of claim 8, further comprising the step of detecting when the material layer is substantially removed from the wafer.

Claim 13 (original). The method of claim 8, further comprising the step of detecting a point at which barrier layer removal is substantially complete.

Claim 14 (previously presented). The method of Claim 13, wherein the step of detecting a point at which barrier layer removal is substantially complete is accomplished using an endpoint detection system.

Claim 15 (previously presented). The method of claim 14, wherein the endpoint detection system is comprised of an optical detection system.

Claim 16 (previously presented). The method of Claim 14, wherein the endpoint detection system is comprised of an infra red detection system.

Claim 17 (previously presented). The method of Claim 14, wherein the endpoint detection system is comprised of a laser detection system.

Claim 18 (previously presented). The method of Claim 14, wherein the endpoint detection system is comprised of a motor current detection system.

Claim 19 (original). The method of claim 8 further comprising the step of conditioning the buff station pads.

Claim 20 (original). The method of claim 19 wherein the conditioning step is accomplished by pressing a lower buff pad against an upper buff pad and rotating each pad at a different velocity.

Claim 21 (original). The method of claim 19, wherein the pad conditioning step is performed between each wafer being processed.

Claim 22 (canceled).

Claim 23 (original). The method of claim 8, wherein the material layer is comprised of aluminum, copper, or tungsten.

Claim 24 (original). The method of claim 8, wherein the barrier layer is comprised of Ti, TiN, Ta, or TaN.

Claim 25 (original). The method of claim 8, further comprising the step of:

- c) supplying a first polishing slurry to the primary polishing station; and
- d) supplying one or more different polishing slurries to the buff station.

Claim 26 (new). The method of claim 8 wherein the step of removing the barrier layer comprises the step of removing the barrier layer using a Politex Supreme buff pad.

Claim 27 (new). The method of claim 8 wherein the step of removing the barrier layer comprises the step of removing the barrier layer using a slurry comprising an abrasive suspension.

Claim 28 (new). The method of claim 27 wherein the step of removing the barrier layer comprises the step of removing the barrier layer using a slurry comprising an aqueous acidic or basic solution.

Claim 29 (new). The method of claim 8 further comprising the step of buffing the surface of the semiconductor wafer after the step of removing the barrier layer, the step of buffing the surface of the semiconductor wafer comprising buffing at the buff station using a buff pad and a second barrier layer slurry comprising a diluted first barrier layer slurry.

REMARKS

Claims 8-21 and 23-29 are pending in the application. Claim 8 has been amended and claims 26-29 have been added. Allowance of the pending claims is requested in view of the amendment to claim 8 and the following remarks.

Claim 8 has been amended to clearly define the invention. Claims 8-21 and 23-25 were previously rejected as unpatentable over Yu ('052), Easter ('955), Somekh ('426), Woo ('891), Mikhaylich ('540) and Easter ('454) either alone or in combination. None of the references disclose or suggest the invention as now claimed. None of the references disclose or suggest the claimed step of removing a barrier layer at a buff station using a buff pad and a barrier layer slurry.

The Examiner has taken the position that any polishing station (except perhaps the first polishing station) can be interpreted as a "buff station." Applicants disagree with this interpretation as it is contrary to common usage in the art of the term. The common usage and the distinction between polishing (and polishing station and polishing pad) and buffing (and buff station and buff pad) can be seen, for example, in all of the following references.

US Patent 5,913,712 (Molinar) states, in column 4, beginning at line 4:

FIG. 2 illustrates a semiconductor wafer 100 following the CMP processing, wherein the surface features of the ILD 160 have been generally removed. A prior art polishing process may involve an initial polishing step on a relatively hard polishing pad (e.g. a polishing pad known by the name IC-60 manufactured by Rodel, Inc.) using an abrasive slurry in order to abrade the surface of the ILD to a generally planar state (FIG. 2). The initial polishing step may in some instances be followed by a rinsing or buffing step in order to remove particles from the surface of the wafer which may have adhered thereto during the planarizing step. The rinsing or buffing step may be performed using a CMP apparatus and a relatively soft polishing pad (such as a SUBA IV polishing pad from Rodel, Inc.) which is supplied with water while the wafer is applied thereto. (emphasis added)

US Patent 5,916,011 (Kim et al.) states, in column 3, beginning at line 10:

FIG. 3 illustrates a polisher 20 including a polishing platen 22 and a finishing platen 24. A polishing arm 26 holds a semiconductor device substrate 27 that includes a layer to be polished and moves the substrate 27 over polishing platen 22. The substrate 27 is then pressed against the polishing platen 22 while the platen is being rotated to begin polishing. Polishing platen 22 includes a polishing pad (not shown in FIG. 3, see FIG. 4). Polishing continues until the desired amount of the layer being polished is removed from the substrate 27.

After material removal, polishing arm 26 moves the substrate 27 onto the finishing platen 24. The finishing platen 24 is also a rotating platen and includes a finishing pad or buff pad that is much softer than pads that are typically used in conventional polishing. The purpose of using a softer pad on finishing platen 24 has traditionally been to smooth the exposed surface of the semiconductor device substrate 27 and to removing residual abrasive particles that lie near the surface of the substrate 27. (emphasis added)

US Patent 6,227,950 (Hempel et al.) states, in column 1, beginning at line 28:

Conventionally, a CMP polishing apparatus has a turntable and a wafer carrier which rotate at respective individual speeds. A polishing pad is attached to the upper surface of the turntable. A semiconductor wafer seated in the carrier is lowered into engagement with the polishing pad, and clamped between the carrier and the turntable, typically through the exertion of downward force by the carrier. An abrasive grain containing liquid (known as slurry) is deposited onto the polishing pad and retained on the polishing pad. During operation, the carrier exerts a certain pressure on the turntable, and the surface of the semiconductor wafer held against the polishing pad is therefore polished by a combination of chemical polishing and mechanical polishing to a flat mirror finish while the carrier and the turntable are rotated.

The semiconductor wafer that has been polished carries abrasive liquid and ground-off particles attached thereto....

Thus, additional processing is typically done prior to the wafer cleaning step. For example, a second polish turntable with a second carrier may be employed, using a relatively soft buffing pad in combination with a cleaning chemical, or ultra pure water alone. The buffing process can be effective at removing the residual slurry and buffing out the surface scratches left from the polishing process before cleaning the wafer. (emphasis added)

And US Patent 6,375,548 (Andreas) states, in column 4, beginning at line 44:

As suggested earlier, the flocculating can occur after the polishing. In one aspect of the present invention, it is contemplated that primary polishing of the substrate may be followed by buffing the substrate along with applying a surfactant comprising material and flocculating at least a portion of the abrasive

material. Primary polishing can include polishing with a CMP slurry or a polishing pad comprising solid abrasive material. Buffing can be less aggressive, that is, use a softer polishing pad, abrasive material that is less abrasive, and/or less chemically active polishing media. Buffing may occur on a secondary platen of a CMP tool as opposed to a primary platen where primary polishing often occurs. (emphasis added)

Each of these patents (Molinar, Kim et al., Hempel, and Andreas) distinguish between polishing (or primary polishing) and buffing. The terms "buffing", "buff," and "buff pad" are terms of art and are well known and well defined to those of skill in the art. Those terms are distinct from "polishing," "polish," and "polish pad." Accordingly, it is clear that the references cited by the Examiner fail to disclose the claimed removal of a barrier layer at a buff station using a buff pad as those terms are defined by the common usage of those skilled in the art.

Claims 9-21 and 23-29 all depend, either directly or indirectly from claim 8. Because claim 8 is believed to distinguish over the references cited by the Examiner, all pending claims are believed to distinguish over those references and to be in condition for allowance. Allowance of the pending claims is therefore earnestly requested.

CONCLUSION

In view of Applicants' amendments and the above remarks, it is now believed that the claims distinguish over the cited references and that the application is in condition for allowance. Such allowance is therefore earnestly requested. Should the Examiner have any questions or wish to discuss any aspect of this application, Applicants request that the Examiner contact the undersigned at (480) 460-8694.

If for some reason Applicants have not requested a sufficient extension and/or have not paid a sufficient fee for this response and/or for the extension necessary to prevent abandonment on this application, please consider this as a request for an extension for the required time period and/or authorization to charge deposit Account No. 50-2091 for any fee which may be due.

Respectfully submitted,



John A. Fisher
Reg. No. 28,505

Dated September 29, 2003